Zootaxa 2230: 57–63 (2009)
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

The Old-World genus *Ceratothripoides* (Thysanoptera: Thripidae) with a new genus for related New-World species

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Abstract

A key is provided to five Old World species that comprise the genus *Ceratothripoides* Bagnall, and the species *C. revelatus* (Priesner) is recalled from synonymy with *C. brunneus* Bagnall. Five New World species previously placed in this genus are here allocated to *Retanathrips* Mound & Nickle **gen.n**., with *Physothrips funestus* Hood as type species.

Key words: tospovirus vector, *Retanathrips* new genus, identification key, *Ceratothripoides*

Introduction

The genus *Ceratothripoides* was proposed by Bagnall (1918a) for one African species from Ghana, based on a single female specimen with distinctive antennae. Subsequent collecting indicated that the antennae of this specimen were deformed, and the species was discovered in several additional African countries. Since 1918, fourteen more species have been described in, or referred to, *Ceratothripoides*, although six of them have been placed into synonymy. Full nomenclatural information concerning all of these taxa is available in the web-based checklist to world Thysanoptera (Mound 2009a). However, the genus itself has remained poorly defined. Mound & Marullo (1996) discussed the five New World species that have been referred to this genus, but listed them as "Ceratothripoides", indicating that these five were not congeneric with the Old World species. As a result these five species have remained with no formal generic assignment.

Until recently, most of the species listed in *Ceratothripoides* have been known only to museum taxonomists. However, Murai (2000) recognized *C. claratris* as an important pest of tomatoes in Thailand, and Premachandra et al. (2005) recorded this species as a vector of a tospovirus on tomatoes in that country. Moreover, Halaweh & Poehling (2009) have indicated that tospovirus vector ability in this thrips is possibly controlled by a recessive allele. The identity and relationships of *C. claratris* are thus now of more general interest from an economic point of view. Moreover, *C. brunneus* has been found recently on three continents other than its native Africa. This species is well established and abundant on various crops in Peninsular Malaysia, two specimens have been examined from Puerto Rico, and a population has been studied from a greenhouse in the Netherlands (Mound & Azidah, 2009). Moreover, Nickle (2009) has recorded *C. brunneus* as being intercepted nine times in quarantine in North America. These records of this African species so far outside its native range, together with the studies on *C. claratris* as a tospovirus vector, have provided the incentive to re-examine the taxonomy and systematic relations of the species listed under this generic name.

Unfortunately, the results presented here are by no means definitive. The lack of field studies in tropical countries, including valid host associations and structural variation within and between populations, have resulted in taxonomic decisions that are not necessarily reliable. Two species recognised here appear to be

Accepted by C. Dalgleish: 20 Aug. 2009; published: 14 Sept. 2009

equally widely distributed across Africa, and are here distinguished on two apparently consistent character states. Both have been taken from various flowers, but there is no information on any host specificity. Two other species are known that appear to have overlapping ranges between the Sahel region and South East Asia, but these are distinguished only by rather weak colour differences for which the biological significance remains equivocal.

The five New World species that are here referred to a new genus are based on particularly few specimens, with no knowledge of intra- and interpopulation variation. The restricted objective here is to clarify the nomenclature, illustrate character states that appear to facilitate identifications, and to indicate problems that require field and laboratory studies on these insects within the tropics of Africa and the Americas.

Ceratothripoides Bagnall

Ceratothripoides Bagnall, 1918a: 201. Type-species *C. brunneus* Bagnall, by monotypy.

Diagnosis: Antennae 8-segmented, segments III–IV with forked sensorium and many microtrichia, segment I with pair of dorso-apical setae. Head with three pairs of ocellar setae; two setae comprising pair I usually arising one in front of the other (Fig. 7) (side-by-side in *funtumiae*); ocellar setae pair III arising within ocellar triangle; compound eyes with no pigmented facets (in *cameroni* and *claratris* with 4 or 5 weakly pigmented facets); maxillary palps 3-segmented. Pronotum with two pairs of posteroangular setae, 3–4 pairs of posteromarginal setae. Mesonotum with median setae close to posterior margin, anterior campaniform sensilla present or absent. Metanotum reticulate, median setae at anterior margin (Figs 1, 5), campaniform sensilla present or absent. Prosternal ferna entire, basantra without setae; mesothoracic sternopleural sutures complete, mesofurcal spinula present, metafurca spinula absent (except *funtumiae*). Forewing first vein with about 7 setae basally, 2 setae distally; second vein with complete row; discal seta present or absent on clavus. Tergites without ctenidia, median setae (S1) far apart, VI–VII with setae S3 much smaller than S4; tergite VIII posterior margin with complete comb of microtrichia (Figs 2, 6); X with dorsal split. Sternites III–VI with 3 pairs of marginal setae, VII with S1 and S2 arising well in front of posterior margin. Male sternites III–VII with 2 or more rows of small pore plates (Fig. 4); tergite IX with median setae slender or slightly stout (Fig. 10).

Generic relationships. Many of the characters listed above, particularly the presence of a pair of dorso-apical setae on the first antennal segment, are shared with the species of *Pezothrips*, also with the legume-flower associated species of the genera *Megalurothrips*, *Odontothrips* and *Odontothripiella*. Nearly all of these species are endemic to the Old World. In contrast to the legume-flower thrips, the species of *Pezothrips* and *Ceratothripoides* have numerous small pore plates (Fig. 4) on the sternites of the males (Mound, 2009b). The character states of the first antennal segment and the male sternal pore plates also occur in species of the *Trichromothrips* genus-group (Masumoto & Okajima, 2005), but males in that group usually have paired drepanae on abdominal tergite IX. The systematic relationships of the nine species currently listed (Mound, 2009a) in *Pezothrips* continue to be problematical. The type species, *P. frontalis* (Uzel), has no comb on tergite VIII, whereas this is present laterally in *P. kellyanus* (Bagnall), but complete and long in *P. dianthi* (Priesner). Eight of these nine species are reputed to have setae S1 on sternite VII closer together than their length, although this is not true of *P. kellyanus*. However, all nine have setae S2 on sternite VII arising at the margin, in contrast to the condition in the species of *Ceratothripoides*.

Key to species

1. Forewings brown or deeply shaded; compound eyes with no pigmented facets 2
-. Forewings uniformly pale with no dark shading; compound eyes with 4 (or 5?) weakly pigmented facets 4

2. Pronotal posteromedian pair of setae almost as long as metanotal median setae (Fig. 8); metafurcal spinula present; male tergite IX medially with two pairs of stout setae (Fig. 10) ..... *funtumiae*
-. Pronotal posteromedian setae scarcely 0.5 as long as metanotal setae (Fig. 1); metafurcal spinula absent; male tergite IX with median setae slender 3
3. Mesonotum and metanotum with no campaniform sensilla (Fig. 1); forewing clavus with 6 or 7 marginal setae but no discal seta (Fig. 1); tergite VIII campaniform sensilla usually anterior to median pairs of setae (Fig. 2)..... ..... *brunneus*
-. Mesonotum and metanotum with pair of campaniform sensilla (Fig. 5); forewing clavus with 5 or 6 marginal setae and one discal seta (Fig. 5); tergite VIII campaniform sensilla posterior to median pairs of setae (Fig. 6)....*revelatus*
4. Legs extensively shaded brown; antennal segment V brown ..... *claratris*
-. Legs yellow; antennal segment V yellow ..... *cameroni*

Ceratothripoides brunneus Bagnall

Ceratothripoides brunneus Bagnall, 1918a: 201
Physothrips marshalli Bagnall, 1918b: 66
Physothrips ventralis Hood, 1918: 116

This species was described originally from a single female with deformed antennae. This female was collected at Aburi, Ghana, 15.xi.1915, in *Cola* shoots and buds. The syntypes of *marshalli* were collected at this same locality, 30.x.1915, from flowers of *Hibiscus sinensis*. The original specimens of these two species have been re-examined and clearly represent the same species. Hood described *ventralis* from "numerous specimens" in various flowers from Kamerun and Nigeria (Ibadan). Pitkin (1978) selected as Lectotype of *ventralis* the female specimen that Hood had labeled as Holotype, and this was collected in Cameroon, 23 November 1915, from flowers of monkshood. This specimen lacks metanotal campaniform sensilla and the forewing clavus lacks a discal seta, but on tergite VIII the campaniform sensilla are posterior to the median setae. The first two character states indicate that, based on this Lectotype, the species *ventralis* is correctly considered a synonym of *brunneus*. The paralectotypes of *ventralis* from Cameroon in the USNM are also identifiable as *brunneus*, and of the 24 paralectotypes of *ventralis* in the USNM from Nigeria that are mentioned by Pitkin (1978), 23 are also identifiable as *brunneus*. However, one paralectotype from Nigeria, collected on *Melia azederach*, is here identified as *revelatus*, based on the two character states indicated in the key above, and a second paralectotype with identical data has also been studied (in BMNH) that also represents *revelatus*. In the Senckenberg Museum Frankfurt there are two female and one male paratypes of *ventralis* that were collected in Cameroon, and these represent *brunneus*.

This species can be distinguished from other members of this genus by means of the characters in the key above, but the position of the paired campaniform sensilla on tergite VIII is not constant even in females, and in males these sensilla are often close to the posterior margin. Specimens of *brunneus* have been examined from the following countries: Ghana, Sierra Leone, Ivory Coast, Nigeria, Cameroon, Ethiopia, Uganda, Congo, Angola, and South Africa (in BMNH & SMF); Netherlands (in greenhouse) (in SMF); Puerto Rico and Peninsular Malaysia (in ANIC). This was one of the most common Thripidae collected during a recent survey of crop thrips in Peninsular Malaysia (Mound & Azidah, 2009). Two males have been studied (in ANIC) that were collected on Citrus at Maricao, Puerto Rico, "4.10.07", and submitted for identification by Prof. Irma Cabrera.

Ceratothripoides cameroni (Priesner)

Taeniothrips cameroni Priesner, 1934: 28

Bhatti (1990) indicated that *C. cameroni* has antennal segment V yellow or shaded and legs yellow, whereas *C. claratris* has antennal V brown, and legs extensively brown. This statement concerning *C. cameroni* is true

for the original specimens from Sudan, but other specimens collected subsequently from that country have the antennae variable in colour, even with segments IV–V light brown, and legs have extensive light brown shadings. Specimens examined from Senegal (in BMNH) are similar to these, and are thus slightly darker than the type specimens from Sudan. Specimens from Nigeria and Saudi Arabia (in BMNH) have rather darker hind femora, and antennal segment V is also brown. In contrast, all available specimens from India and Thailand have brown hind femora and brown antennal segment V, and these are identified as *C. claratris*. Whether these slight differences in colour represent two distinct species, or whether they are symptoms of intraspecific variation, as suggested by zur Strassen (1975), remains unclear. The palest specimens, those that would be associated with the name *C. cameroni*, appear to come from the more arid areas, whereas the darker specimens, that would be associated with the name *C. claratris*, come generally from more humid areas. As indicated below, the two names are here retained because *C. claratris* is used for a form that is of economic significance, but the biological reality of these two colour forms requires further field studies.

Ceratothripoides claratris **(Shumsher)**

Taeniothrips claratris Shumsher, 1946: 178
Mycterothrips moultoni Seshadri & Ananthakrishnan, 1954: 213
Ceratothrips reticulatus Reyes, 1994: 183 [synonymised by Bhatti, 2003: 8]

The significance of this species is discussed above under *C. cameroni*, of which it is possibly a variant. The two remain separated here primarily because the name *C. claratris* has become widely used in Asia in economic entomological literature (Premachandra et al., 2005). The name *claratris* has been used for specimens from various localities across India and Thailand, and also from Luzon in the Philippines (Bhatti, 1990, 2003).

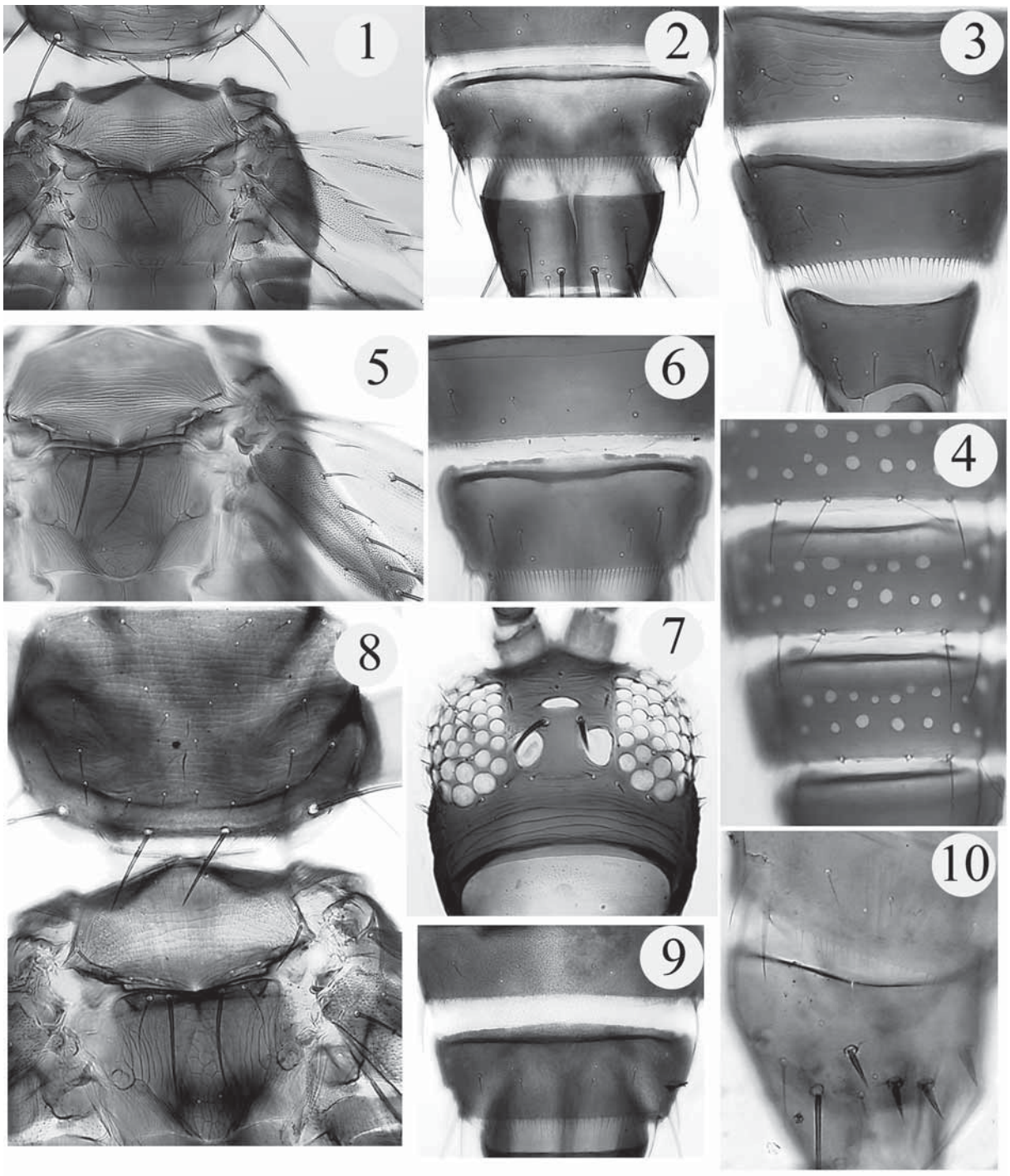
Ceratothripoides funtumiae **(Bagnall)**

Physothrips funtumiae Bagnall, 1913; 292

This species remains known only from the original specimens from Uganda (in BMNH, SMF and USNM), together with 15 females from southern Nigeria (in BMNH). In contrast to the other species placed in this genus, the head bears ocellar setae pair I in the normal position for Thripidae, side-by-side; the other four species have these two setae placed irregularly or even one in front of the other (Fig. 7). Moreover, the metanotal reticulation is almost equiangular or even linear rather than transverse, and paired campaniform sensilla are present (Fig. 8). Campaniform sensilla are also present near the anterior margin of the mesonotum, and the metafurca bears a spinula. The forewing clavus is similar to that of *revelatus*, with five marginal setae and one discal seta. Antennal segments III–IV are brown with the apex contrastingly yellow (much as in *Pezothrips kellyanus*), and antennal segment VIII is twice as long as VII. In females, the campaniform sensilla on tergite VIII are anterior to the median setae. In males, tergite IX bears two pairs of moderately stout setae medially (Fig. 10), and sternites III–VII bear a transverse pore plate at the anterior and three irregular rows of about 20 small pore plates behind this. Of the specimens of this species from Nigeria, four were collected with *C. brunneus* at Ibadan in February, 1964, on "lily flower".

Ceratothripoides revelatus **(Priesner) stat. rev.**

Taeniothrips revelatus Priesner, 1937: 169



FIGURES 1–10. *Ceratothripoides* species. *C. brunneus* 1–4: **(1)** Pronotum, mesonotum, metanotum and forewing clavus. **(2)** Tergite VII–IX. **(3)** Tergites VII–IX of male. **(4)** sternal pore plates of male. *C. revelatus* 5–7: **(5)** Mesonotum, metanotum and forewing clavus. **(6)** tergites VII–VIII. **(7)** Head. *C. funestus* 8–10: **(8)** Pronotum, mesonotum and metanotum. **(9)** Tergites VII–VIII. **(10)** Tergites VIII–IX of male.

Although the original description of *revelatus* mentions an "allotype", neither holotype nor type locality was specified. Priesner based the species, in part, on specimens identified by Karny (1925) as *T. ventralis*, from Kampala, Uganda, but listed further specimens from Njala, Sierre Leone, and Rutshuru, Belgian Congo. There is a long series of syntypes of *revelatus* in BMNH from Kampala, Uganda, 15.i.1921, bearing Karny's handwriting and identification as *ventralis*. Moreover, one female "paratype" of *ventralis* in BMNH actually represents *revelatus* and has the following data: S. Nigeria, Ibadan, *Melia azederach* fls, 14.i.1915 (Jobbins-

Pomeroy). In this collection there is also one female and one male of *revelatus*, labeled: Ibadan, Moor Plantation, 11.v.1964, in lemon flowers.

Although long considered a synonym of *brunneus*, this species can be distinguished by means of the indicated character states. In addition to the material listed above, the following specimens in the BMNH collections are here identified as *revelatus*: Ghana, Tafo, iv–v.1971, 14 females, 4 males (labelled *brunneus*) from cocoa flowers; Sao Tome, 15.vii.1974, 5 females 1 male from cocoa flowers; Kenya, Nairobi National Museum, 6.ix.1986, 25 females, 6 males from *Whitefieldia elongata* flowers. The males in the series from Nairobi are unusual in that they are almost yellow rather than brown in colour.

The countries from which this species is now recorded are: Ghana, Sierra Leone, Nigeria, San Tome, Angola, Congo, Mozambique, Kenya and Uganda.

Retanathrips gen. n. Mound & Nickle

Type-species *Physothrips funestus* Hood, 1915

Members of this new genus apparently share the character states of *Ceratothripoides* listed above, judging from the few available specimens and the published descriptions. These New World species differ from the species of *Ceratothripoides* as follows: tergite VIII with posteromarginal comb absent at least medially; sternite VII setae S2 close to posterior margin; ocellar setae pair I arranged transversely. The five species listed by Mound & Marullo (1996) as "Ceratothripoides" are here re-assigned to this new genus. However, since these species are known from so very few specimens, their structure and identity requires further study on freshly collected material.

Species included. *Retanathrips chilticus* (Johansen, 1986 : 354) **comb.n**. Described in *Ceratothripoides*, this species is based on a single female, collected from *Datura arborea* flowers, 26.vii.1981, in Hidalgo, Mexico. The original illustration indicated that the comb on the posterior margin of tergite VIII is very weak medially.

Retanathrips funestus (Hood, 1915 : 24) **comb.n.** Described in *Physothrips* from Texas, this species is considered a senior synonym of *Taeniothrips martellorum* Medina Gaud from Puerto Rico (Mound & Marullo, 1996). Specimens have also been examined from Mexico, Jamaica, Trinidad and Costa Rica.

Retanathrips inconstantis (Johansen & Mojica, 1986 : 372) **comb.n.** Described in *Wegenerithrips*, this species is based on two females, collected from mosses, 24.x.1982, in Veracruz, Mexico. The description indicated that there is no posteromarginal comb on tergite VIII, and the setal row on the forewing first vein is almost complete.

Retanathrips lagoenacollus (Moulton, 1933 : 130) **comb.n.** Described in *Taeniothrips*, this species is known only from two females and one male collected at "St. Theresa, Brazil", 27 & 29.vi.1928.

Retanathrips silvestris (Hood, 1935 : 83) **comb.n.** Described in *Taeniothrips* from Panama, this species is recorded from Costa Rica and Trinidad. However, as indicated by Mound & Marullo (1996) the specimens under this name are possibly merely large individuals of *R. funestus*.

Acknowledgements

The continued support of several colleagues is gratefully acknowledged: Richard zur Strassen, Senckenberg Museum, Frankfurt (SMF); Jon Martin, Natural History Museum, London (BMNH); Sueo Nakahara, U.S. Department of Agriculture, Beltsville, Maryland, USA (USNM). We are grateful to Dr Masami Masumoto of Yokohama Plant Quarantine Station, for many valuable comments on classification problems among Thripinae, and to Prof. Irma Cabrera of Puerto Rico for sending specimens for identification. Gary L. Miller and Matt Buffington kindly provided comments on a draft.

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